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ABSTRACT

This paper describes a teacher preparation instructional unit on the "Structure of Knowledge" that was designed to help students learn to think like Jerome Bruner and David Ausubel rather than merely acquire knowledge about them, while simultaneously improving students' thinking skills. The unit used Sternberg's triarchic theory to identify thinking skills and to plan instructional activities intended to help students think more intelligently about their academic work. The goals of the instructional unit were for students to: (1) use their knowledge about Bruner and Ausubel; (2) gain experience in assessing and preparing instructional materials; and (3) improve their intellectual skills within the contexts of both learning and teaching. The unit was tested with 23 college students enrolled in "Human Learning and Instruction" in which all students were required to keep a journal about out-of-class teaching episodes in which they connect course concepts with their own teaching experience. There were three primary learning activities in the unit: representation preference essays; handout analysis; and handout design. Unit evaluation data showed that students found all three instructional activities worthwhile and that the unit succeeded in helping students think like the theorists. The appendix includes background information on Bruner's and Ausubel's theories and Sternberg's triarchic theory of intelligence, a lesson plan, and handouts. (GLR)

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Thinking about Learning from the Perspectives of Bruner and Ausubel

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Paper presented at the American Psychological Association Convention Symposium "Teaching Undergraduates How To Think In Educational Psychology", August 17, 1991, San Francisco

Abstract

An instructional unit on the "Structure of Knowledge", was designed to help students learn to think like Bruner and Ausubel rather than merely acquire knowledge about them, while simultaneously improving students' thinking skills. The unit used Sternberg's triarchic theory to identify thinking skills and to plan instructional activities intended to help students think more intelligently about their academic work. There were three primary learning activities in this unit: representation preference essays, handout analysis and handout design. The goals of the instructional unit were for students to: (a) use their knowledge about Bruner and Ausubel, (b) gain experience in assessing and preparing instructional materials, and (c) improve their intellectual skills within the contexts of both learning and teaching. Unit evaluation data show that students found all three instructional activities worthwhile and that the unit succeeded in helping students think like the theorists.

Teacher-preparation programs have been under attack for failing to provide prospective teachers with the "knowledge-base" needed to be effective in the classroom. Efforts like New Jersey's "alternate route to teacher education" and the national "Teach for America" involve recruiting and training non-education majors to become classroom teachers. Teacher education is obviously in need of reform - but what changes are needed?

This paper is based on the assumption that a key modification needed in teacher education goes beyond the conventional redefinition of the critical knowledge base. Prospective teachers need to know how to **apply** what is stored in their knowledge base. Rather than merely **learning** the essentials of educational psychology, they need to develop their **thinking** as applied educational psychologists.

In my course, "Human Learning and Instruction", development of thinking is based on Sternberg's (1985) triarchic theory of intellectual performance. The componential subtheory is used to help identify metacognitive and cognitive skills; the two-facet subtheory is used to help students automatize selected intellectual skills and to help students deal with novel aspects of intellectual tasks; and the contextual subtheory is used to help future teachers think about how they can use their intellect for adapting to, selecting, and shaping classroom and other environments. Since 1986 I have been developing, using, and training teachers to use a "Rich Instruction Model" of improving

students' intellectual performance. This model has three basic components: instructional objectives, methods, and transfer activities. There are three types of instructional objectives: thinking, affective and content. Instructional methods include activating students' prior knowledge, communicating to students immediate and long term benefits of the targeted objectives, and using multiple modalities. Transfer activities include applications within subject across tasks, across subjects, and to everyday life. My classroom methodologies usually entail active learning strategies, including cooperative learning. Artz (1990) found that cooperative learning can spontaneously evoke students' metacognition. Cooperative learning can also improve students' self esteem, interpersonal relations, and internal locus of control (Slavin, 1990). Finally, cooperative learning is consistent with Vygotsky's "zone of proximal development" because in heterogeneous groups, low achieving students can improve their performance with the guidance of high achieving students.

This paper describes a unit on the "Structure of Knowledge", in which students acquire knowledge about the theories and approaches of Bruner and Ausubel, and apply this knowledge- thereby learning to think like Bruner and Ausubel, while simultaneously improving their own intellectual skills. At the end of this unit, students were asked to evaluate its components, so that revisions can be made for the future.

I will describe the sequence of instructional activities comprising this unit, and then present the data.

Method

Sample

The class consisted of 23 students enrolled in Human Learning and Instruction, the second course of the educational psychology sequence for prospective teachers. Of these, 17 were female, 6 were male; 13 were black, 7 were hispanic and 3 were white. The class met two times a week for approximately 1 1/2 hours per period. As a course requirement, all students must engage in and keep a journal about at least ten out-of-class teaching episodes in which they connect course concepts with their own teaching experience.

Procedures

Learning Activities.

Activity 1: Introduction to the Structure of Knowledge

Students were given an assignment to activate their prior knowledge and experience with knowledge structure representations from both teaching and learning perspectives. This activity sets the stage for students to use the knowledge acquistion skill that Sternberg (1985) calls selective comparison, in which prior knowledge is compared with material to be learned. Students wrote two brief essays in which they reflected on their representation preferences when learning and when teaching. The directions for this activity are presented below:

> The theories of Bruner and Ausubel are concerned with how to structure material for students to learn. As an introduction to their theories, please reflect on your own experiences as a student and a teacher. First write a brief self portrait (a paragraph) about yourself representing material as a learner, then write a brief self portrait (a paragraph) about yourself as

a teacher. The first two paragraphs below are intended to stimulate your thinking for your self portraits.

Representations when Learning

Which kinds of representations do you prefer when learning new material? Do you prefer **physical** representations, such as movement - bodily actions as when acting in a play , **auditory** representations involved in listening (to a teacher, a tape), **verbal** representations, like taking lecture notes or reading a text, **pictorial** representations like pictures and diagrams? Many people have strong preferences, for example, like whether directions to an unknown location are given through a written set of steps to follow or through a map. Do you prefer to use just one of these representation forms when learning new material or would you rather have multiple?

Representations when Teaching

Which kinds of representations do you usually use when teaching? Do you have preferences for whether you are speaking, writing on the blackboard, using pictures, videos, and diagrams or listening to students? Do your students know in advance the major topics that will be coming up in the lesson? What kinds of representation activities do you ask your students to engage in, including: listen about what their learning, read, discuss, write, dramatize, and construct pictorial representations of material to be learned?

Why do you think you are being asked to write these?"

To help students with this assignment, relevant prior knowledge was activated. Bruner's representation modes: enactive, iconic and symbolic were connected with prior instruction in this course on Gardner's Multiple Intelligences: tactile-kinesthetic, visual-spatial, mathematical, and linguistic; and with prior knowledge of Piaget's stages of intellectual development: sensori-motor, concrete and formal operations, from a prerequisite course in the educational psychology sequence. The class discussed classroom methods previously used in this course and how they related to these concepts. Our class had experience with each of Bruner's modes-

enactive student dramatizations, diagrams and conventional symbolic professorial lectures.

After students wrote their essays, there was a class discussion of the immediate and long term benefits of this assignment. At the class following this assignment, the class saw and discussed the results - that is, which modes are preferred from teaching and learning perspectives (see Table 1). Students drew tentative conclusions from the data presented. These activities helped the future teacher think about: the value of multiple representations, the comparisons between their own learning and teaching activities, individual and developmental differences in representation preferences, and how new material can be connected to prior knowledge and experience.

ACTIVITY 2: HANDOUT ANALYSIS

Students were given materials with brief descriptions of Bruner's and Ausubel's views on the Structure of Knowledge (see Appendix). These materials were designed to complement others on these theorists from students' class booklet and course text. The materials contained questions orienting students to apply concepts about the structure of knowledge. Students applied Bruner's concepts of mode, economy, and power of knowledge representations by analyzing and critiquing a booklet of approximately 80 pages of handouts they received in this class. For example, students identified a graphic representation of Sternberg's triarchic theory as primarily an illustration of Bruner's iconic mode, and a corresponding list of triarchic

theory components as a symbolic representation (see Appendix). Students commented that the graphic mode was powerful, because it enabled them to see how the parts of the theory were related to each other, but was not economical because it had too much detail. Handout analysis based on Bruner's ideas about the structure of knowledge led to discussions of teachers' development and selection of instructional materials, and how using effective materials depends upon the immediate and long-term purposes of the handouts, students' individual differences, prior knowledge, and levels of development.

Bruner's views on the structure of knowledge were related to two instructional approaches: discovery and reception learning, both of which had been discussed earlier during the semester. Students discussed their own experiences as teachers and learners using these approaches. The discussion of reception learning led to the distinction between rote and meaningful learning, which had also been discussed previously. Ausubel was introduced at this point by showing students advanced organizers for meaningful reception learning in their class booklet, and by discussing Ausubel's key relevant points (see Appendix).

Activity 3: Designing a Handout

Analyzing and critiquing handouts was intended to set the stage for students to develop their own handout, based on Bruner's and Ausubel's ideas regarding the structure of knowledge. Simultaneously students gained experience applying metacognitive executive management and strategic knowledge.

Students were guided to think metacognitively through the directions they received for the cooperative handout design activity (see Appendix). Students had had repeated prior experiences with both forms of metacognition in our class.

As an introduction to this activity, students were given material with the information below, which was intended to stimulate their thinking about instructional material design.

Designing Handouts for Teaching

Which kinds of handouts work best? Most people learn best when they get several different types of representations of the material they are to learn. Using multiple senses helps students learn about their own preferred ways of processing information and helps them use a variety of complementary types of information sources to aid and enrich understanding.

Handout Variations

Teachers often prepare handouts for their students . Handouts vary in purpose, length, and appearance. The different functions include:

a. providing content with some detail
b. providing an overview or outline of content
c. illustrating a particular point
d. helping students learn by providing a visual representation of information to be learned (which one can return to unlike a beautiful illustration on an erased blackboard!).
e. supplementing **oral** instruction with a **visual** representation, thus providing information in different sensory modalities; or supplementing material presented in written words with images of them.
f. providing a worksheet for learning activities
g. helping students organize information
h. helping students review for tests

What are examples of these functions from our handouts this semester? Analyze the yellow class text, which is a compilation of handouts, as well as other materials I have given you, for illustrations of types, forms, and functions of handouts. This activity is intended to help you identify some of your prior knowledge and experience with handouts.

After briefly discussing various handouts and their

functions, students were given the directions for their cooperative learning handout design project. There were five basic steps: assign groups and roles, plan content, establish context, prepare draft, and turn in. Students were introduced to the Rich Instruction Model, so they could see how development of their executive management metacognition was being integrated into their content learning.

Using principles of cooperative learning acquired earlier in the semester, students created their own groups, while I monitored their construction to maximize heterogeneity. As students worked in their groups, I circulated from group to group to ensure students understood the directions and were on task. Almost half of the groups required some intervention to help orient them to appropriate activities. The task entailed developing a handout <u>on</u> Bruner and Ausubel while applying principles <u>of</u> Bruner and Ausubel. Thus the two theorists were both the medium and the message. The content of the handout was to address descriptions, advantages and disadvantages of learning approaches of Bruner (discovery learning) and Ausubel (meaningful reception learning). The form of the handout was to incorporate both theorists' contributions regarding the structure of knowledge: Bruner's mode, economy and power; Ausubel's advance organizers. I intentionally did not provide a model handout for them to work from, because prior experience with this class indicated they tended to become constrained by framework of models provided, rather than using them to stimulate their own

thinking. After finishing the group handout design drafts, students were given two models of possible handouts based on their assignment (see Appendix).

Evaluation

At the end of the instructional unit students were asked to use a four point scale (from strongly agree to strongly disagree) rating ten criterion statements about the instructional unit.

Results

Evaluation results indicated that overall the instructional unit succeeded in achieving its goal of helping students to learn to think like educational psychologists (see Table 2). The unit appears to have done a slightly better job of teaching students to think like or apply Bruner (86% agreement) than Ausubel (80%). Students generally understood the reasons for studying this unit, as well as the reasons for each of the three major learning activities. The rationale for the representation preference essays was understood most, while the rationale for the handout design activity was understood least. Students almost uniformaly felt indicated all three activities were worthwhile, with the handout design activity receiving the best ratings. Thirty-five percent of the students disagreed with the statement that their cooperative learning group worked together well. Virtually all students (93%) felt their group needed more time for developing the handout. Slightly more than half the students (57%) felt the handout design cooperative learning activity was more difficult than our earlier cooperative learning activities. A major

problem with the cooperative learning activity was that 73% of the students reported having difficulty understanding what to do, although students were given extensive written instructions to read as homework before the activity. Despite these limitations, most students (80%) felt that this unit was less boring than other sections of this course, and that it will be useful for their future teaching.

Discussion

The results suggest that each of the three major learning activities from the unit on the Structure of Knowledge contributed toward prospective teachers' professional development, helping them to learn to think like Bruner and Ausubel. In addition, through these activities I obtained useful feedback on my own teaching and design of instructional materials. For example, before students wrote the representation preference essays, I was not aware how much they enjoyed the lesson in which students dramatized Skinner's principles of operant conditioning, using the Intregrative Learning approach (Kline, 1988). Success of the representation preference essays may not have occurred if students did not have prior experience with each of the basic modes. Students' analysis and critique of handouts in the class booklet made me aware of some of the materials' strengths and weaknesses. Some handouts I considered economical, students experienced as uneconomical; in other cases, students pointed out potential power in handouts that I designed, but overlooked this feature!

According to the unit evaluation results, the cooperative learning handout design activity appears to have been affected by at least four factors: group dynamics, time constraints, task difficulty and clarity of task requirements. In future lessons I will utilize this information in two ways. First, I will increase the time allotment for groupwork and simplify the written instructions, making them more econcomical and powerful. Second, I discuss with prospective teachers these four factors and how they can affect students' task performance. Group dynamics can be a common problem with cooperative learning groups, and especially when working with younger students, teachers often need to train students to work effectively with their peers. I will try to model for students a guiding theme of my teaching: to recycle informal and formal evaluation results into future improvement plans. Although the purpose of handout design activity was less clear than the purpose of the representation preference essays and the handout analysis, students' experiences engaging in the cooperative handout design activity had a strong impact on its perceived value.

Table 1

Percentage of Students' Representation Preferences*

\Mode Self\	Physical	Auditory	Verbal	Pictorial
Learner	60	47	60	67
Teacher	40	53	47	67

* N=15, multiple representation preferences accepted, consequently percentages add to more than 100%

Table 2
Percentage of Agreement with Evaluation Criteria

	SA*	A	D	SD	N
1. I understand why we were learning about the structure of knowledge.	27	40	27	7	15
2. I understand the reasons for the following in class activities: a. essays on representation preferences	33	60	--	7	15
b. handout analysis	38	38	15	8	13
c. handout design	25	33	17	25	12
3. These activities were **not** worthwhile. a. essays on representation preferences	--	7	64	29	14
b. handout analysis	8	8	58	25	12
c. handout design	--	--	66	33	12
4. Compared to other sections of this course, this one was more boring.	7	13	60	20	15
5. Compared to other cooperative learning activities in this class, the last one was harder.	36	21	36	7	14
6. I had trouble understanding what to do on the last cooperative learning task.	20	53	20	7	15
7. My last cooperative learning group worked together well.	29	36	14	21	14
8. This unit helped me learn to think like (**apply** the ideas of): a. Bruner	20	53	27	--	15
b. Ausubel	20	47	27	7	15
9. Our group needed more time than was allotted for developing the handout.	53	40	7	--	15
10. This unit on the structure of knowledge will be useful for my future teaching.	27	53	7	13	15

*SA=strongly agree, A=agree, D=disagree, SD=strongly disagree

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Appendix

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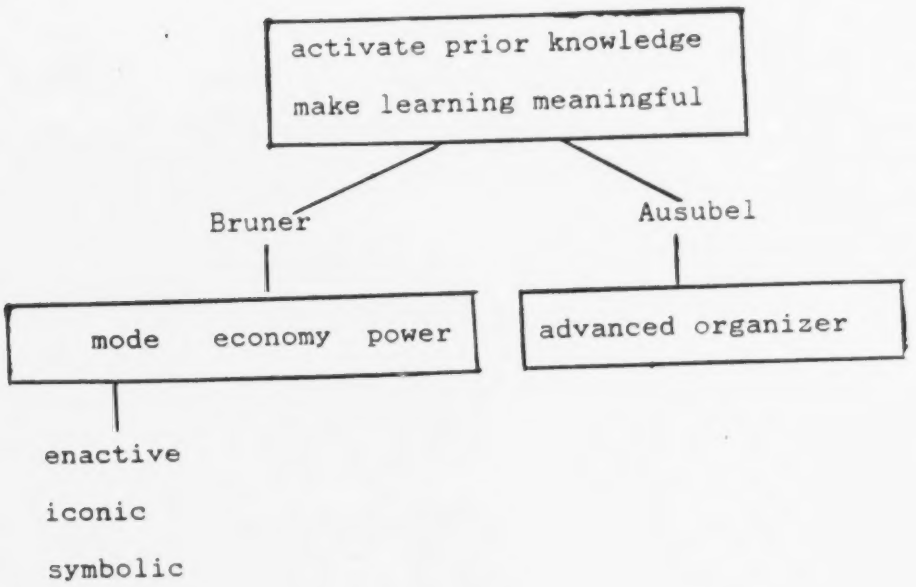
1. Structure of Knowledge

2. Sternberg's Triarchic Theory

3. Assignment - Cooperative Handout Design

4. Model Handouts

Structure of Knowledge



I. Bruner

Bruner's theory of the structure of knowledge is that there are three ways to characterize its structure: its mode, economy and power.

Mode. Bruner identifies three learning modalities or ways of representing information in any domain. They correspond to the different ways children perceive reality at different ages. Bruner believes that any idea or problem can be presented to any learner in a simple enough way that the learner can understand it in a recognizable form. Bruner believes that material should be presented to students and then reintroduced to them in progressively more complex ways as they develop and mature. This is the essence of his **spiral curriculum.**

1. **Enactive**: during early childhood (up through preschool, children tend to think about the world in terms of their actions. Physical activity - movement is used for understanding.

2. **Iconic** : in middle childhood they tend to represent the world in terms of concrete models, mental images, or pictures. These representations stand for the concepts but do not define them fully.

3. **Symbolic**: during late childhood and early adolescence children begin represent the world in terms of abstract representations of verbal, mathematical and logical symbols, which more fully define the concepts they represent.

What are examples of these three representations which you have had in this class this semester?

Economy Bruner defines the economy of a representation in terms of the amount of information which must be held in mind and processed to achieve comprehension. The more items there are, the greater the number of steps needed to complete information processing, and the less the economy. Economy varies with the mode in which it is represented, the sequence in which it presented, and the manner in which it is learned.

Which are our most economical and uneconomical handouts?

Power Bruner defines power in terms of the generativity of a representation - how much it stimulates the learner to make connections between matters which might, on the surface, appear to be quite separate. This is similar to Sternberg's knowledge acquisition skill of Selective Combination.

Which of our handouts are powerful; which aren't? Why?

2. Ausubel

Ausubel's theory of structuring knowledge is based on the concept that meaningful learning depends upon organizing material in a way that makes material meaningful by connecting it with ideas in the learner's cognitive structure. According to Ausubel, teachers can facilitate meaningful learning by using **advanced organizers**. Advanced organizers are abstract, general, and inclusive introductory materials that provide a framework which pre-organizes material to be learned. The framework provides a stable, general cognitive structure which students can use to **subsume (or incorporate)** specific information. They help the learner **organize** new material and **connect** new material to one's prior knowledge, thereby increasing meaningfulness and the liklihood students will **learn** and **retain** it.

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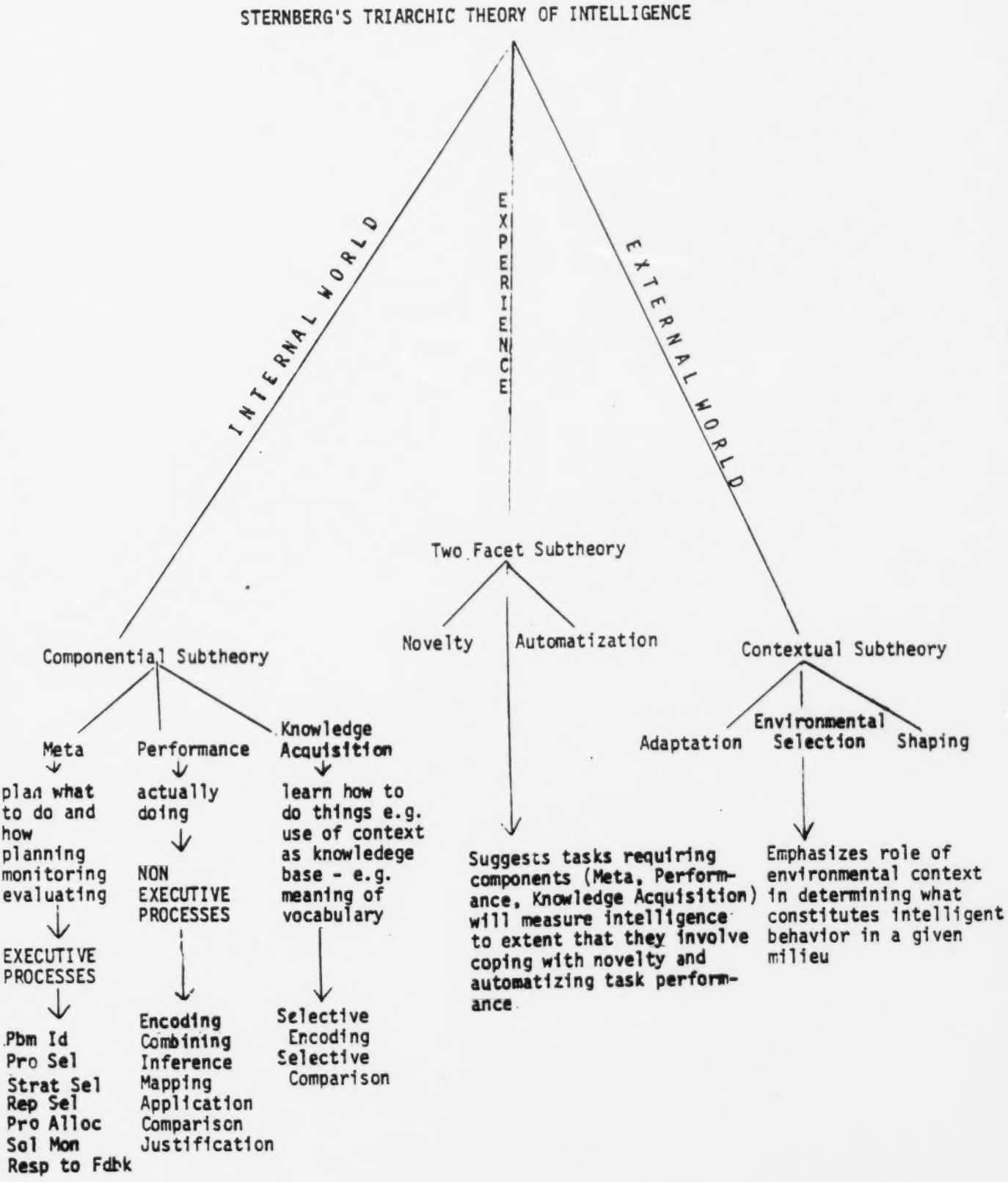

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PRINCIPAL ABILITIES UNDERLYING INTELLIGENT BEHAVIOR

Subtheory of Triarchic Theory

Componential Subtheory	1.	Recognizing and defining the nature of a problem	
	2.	Deciding upon the processes needed to solve the problem	
Internal World of Student 1-12	3.	Sequencing the processes into an optimal strategy	(skills used in planning, monitoring & evaluating)
	4.	Deciding upon how to represent problem information	
	5.	Allocating mental and physical resources to the problem	
Meta Component 1-7	6.	Monitoring and evaluating one's solution processing	EXECUTIVE PROCESSES
	7.	Responding adequately to external feedback	
	8.	Encoding stimulus elements effectively	
Performance Component 8-12	9.	Inferring relations between stimulus elements	
	10.	Mapping relations between relations	(skills actually used in carrying out task) performance
	11.	Applying old relations to new situations	
	12.	Comparing stimulus elements	NON EXECUTIVE PROCESSES
Experience of Student 13 - 14	13.	Responding effectively to novel kinds of tasks and situations	
	14.	Effectively automatizing information processing	
External World of Student 15 - 17	15.	Adapting effectively to the environment in which one resides	
	16.	Selecting environments as needed to achieve a better fit of one's abilities and interests to the environment	
	17.	Shaping environments so as to increase one's effective utilization of one's abilities and interests	

Sternberg 1983: HOW CAN WE TEACH INTELLIGENCE ?

Assignment: Cooperative Handout Design

I. Objectives

1. Content Objective: to help you learn to think like Bruner and Ausubel by applying their ideas on the structure of knowledge to the design of a handout. The **content** of the handout will be about their **learning approaches.**

The handout will be targeted at a hypothetical scenario of high school students who are taking your psychology class. You will teach them Bruner's and Ausubel's approaches to learning.

2. Thinking Skill Objective: Application - to apply the abstract concepts you learn to concrete instructional tasks.

3. Metacognition during this activity:

A. Executive management:

planning, monitoring, and evaluating the construction of a handout, ensuring quality content and design.

B. Strategic knowledge:

1). **WHY should I make a handout?**

Most teachers make up their own and/or select instructional material to be handed out to students. Given you will probably be designing/choosing instructional material, if you learn to apply characteristics of effective knowledge representations, you are more likely to succeed in helping your students acquire, comprehend, retain and transfer information you want them learn.

2). **WHY should apply the theories of Bruner & Ausubel?**

Bruner's and Ausubel's theories have useful implications for representing information to be taught in ways that will facilitate the achievement of your teaching objectives. Their ideas on the structure of knowledge illustrate the characteristics of effective representations, upon which handouts should be based. Understanding and applying Bruner's and Ausubel's key principles about how information should be structured can help you become a more successful teacher.

3). **HOW will I apply their theories?**

In a group you will design a handout in which you will:

1.structure knowledge according to Bruner's:

a. mode
b. economy
c. power

2. use Ausubel's Advanced Organizers.

4. Attitude Objective: Curiosity - to stimulate interest and inquiry into Bruner's and Ausubel's approaches to learning and their ideas about the structure of knowledge.

II. **Lesson Plan Core**

A. Purpose

The immediate benefit is to immerse yourselves in Bruner and Ausubel so that by concete experience you will better undertand their principles of learning and instruction.

The long term value is for you to learn to think about the design of instruction from the perspective of educational psychology.

B.Prior Knowledge

The class previously wrote about and discussed their own experiences with handouts from two perspectives: as a learner and as a teacher. In addition, students analyzed the handouts they have received in this course in terms of the characteristics of Bruner's and Ausubel's theories.

C. Method

1. Assign Groups & Roles
2. Plan Content
3. Establish Context
4. Prepare Draft
5. Turn in

1. Assign Groups and Roles

a. Assign yourselves to Cooperative Learning groups of three students. Remember to maximize group heterogeneity and to try to create groups of people who have not worked together during previous classes.

b. Check up on (monitor) your group composition.

c. Assign group members to their roles.

Group Roles:

1. recorder: writes down the content and prepares the final handout
2. moderator: makes sure everybody contributes and nobody dominates
3. (&4). monitor(s): checks up on the recorder and moderator- monitoring their performance in their roles to make sure they are fulfilling their responsibilities effectively.

2. Plan Content

You will be focusing on Bruner's Discovery Learning and Ausubel's Meaningful Reception Learning. As a group, using your course books as resources, determine the content to be included in your handout. **PARAPHRASE** any material from books. **DO NOT COPY** it.

CONTENT

a. a brief summaries of both approaches
b. advantages of both approaches
c. disadvantages of both approaches

3. Establish Context

Establish a context for your handout by discussing and deciding how you would use it for teaching your hypothetical high school students about Bruner's Discovery Learning and Ausubel's Meaningful Reception Learning.

Do not feel limited by the identified functions. Other uses of the handout as a teaching/learning tool are acceptable.

4. Prepare Draft

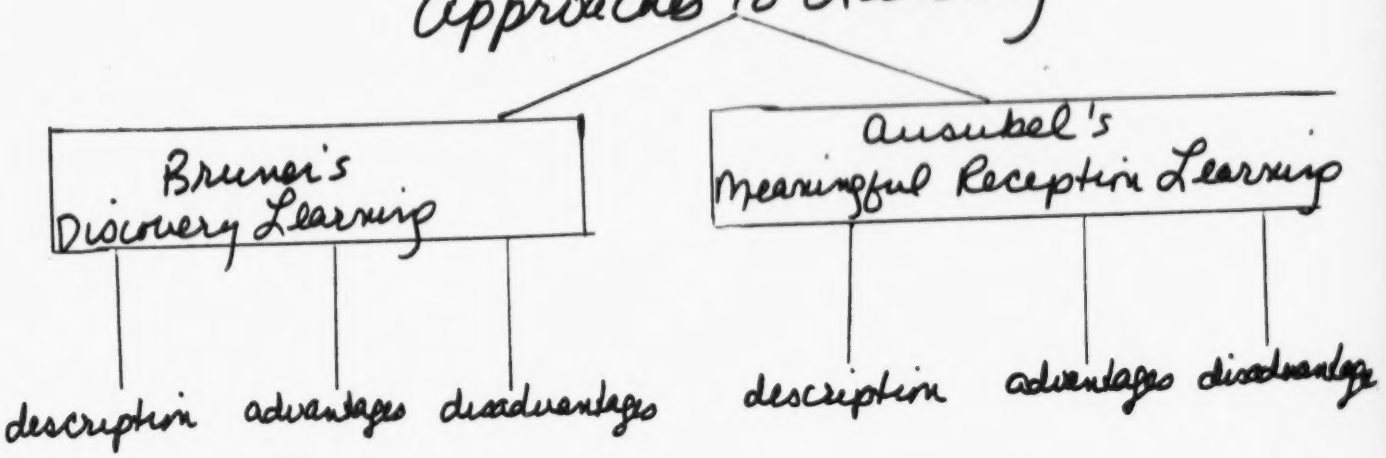
Plan the construction of your handout. Your handout will be based on Bruner's and Ausubel's teaching principles as identified below. This is the part of the activity in which you will be thinking like Bruner and Ausubel, applying their ideas to your handout design. Always prepare a **draft** of your handout before attempting to do a final copy. While preparing the draft, **monitor** your work in progress, making sure that you are including the right content and that you are faithfully applying Bruner's and Ausubel's teaching principles. **Evaluate** your handout as the draft is taking shape, and **Revise** your plan as appropriate.

5. Turn In

At the end of today's class you should turn in the **draft** of your group's handout with the name of all group members on it.

Model Handout

1. Advance Organizer



2. Lesson Handout

Approach	Description	Advantages	Disadvantages
Bruner's Discovery Learning			
Ausubel's Meaningful Reception Learning			

Model Handout

1. Advance Organizer

A. Approaches to Learning
   1. Bruner's Discovery Learning
   2. Ausubel's Meaningful Receptin Learning

B. Advantages of both Approaches

C. Disadvantages of both Approaches

2. Lesson Handout